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Atty. Docket No. MTKI-04-332A-1

IN THE UNITED STATES PATENT & TRADEMARK OFFICE

IN RE APPLICATION OF:	:
Hung-Ju LEE et al.	: GROUP ART UNIT: 2621
APPLICATION NO: 09/401,132	:
FILED: SEPTEMBER 22, 1999	: EXAMINER: WONG, Allen C.

FOR: APPARATUS AND METHOD FOR OBJECT BASED RATE CONTROL IN A CODING SYSTEM

I hereby certify that this document is being facsimile transmitted to the USPTO or deposited with the United States Postal Service as first class mail in an envelope addressed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on ~~October 9, 2007~~. OCTOBER 15, 2007.

By: Jennie Heaton

DECLARATION UNDER 37 C.F.R. 1.132

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SIR:

Now comes Jonathan Liou, who declares and states that:

1. I am currently employed by MediaTek Inc. as a Patent Engineer in the LIP (Legal/Intellectual Property) group. I have been continuously employed by MediaTek Inc. since September 2006. Prior to that time, I was employed by the United States Patent and Trademark Office as a Patent Examiner in the area(s)/field(s) of multiplexing and data communications.

2. I received a Bachelor's degree in Electrical Engineering from the University of Pittsburgh in 2003, and a Master's degree in Electrical Engineering from the Ohio State University in 2004.

3. I have read the above-identified application. I have also reviewed U.S. Patent No. 6,055,330 to Eleftheriadis et al. (hereinafter "Eleftheriadis"), U.S. Pat. No. 5,606,371 to Klein Gunnewick (hereinafter "Klein Gunnewiek"), and U.S. Pat. No. 5,223,926 to Stone (hereinafter "Stone").

4. I understand that the claims of the above-identified application have been rejected as being unpatentable over Eleftheriadis in view of Klein Gunnewick.

5. I understand that one independent claim of the above-identified application is directed to a method for allocating bits to encode a plurality of frames of an image sequence, each frame of said image sequence comprising a plurality of objects, said method comprising the steps of:

(a) determining a target frame bit rate, T_{frame}, for each of the frames in accordance with a quantizer scale for each object in the frame;

(b) allocating said target frame bit rate among the plurality of objects in accordance with the formula:

$$V_i = K_i \times T_{frame}$$

where V_i is a target object bit rate for each object, and K_i is proportional to an average pixel value for the object;

(c) generating the quantizer scale for each of said plurality of objects in accordance with said target object bit rate, wherein said quantizer scale provides coarser and/or fewer allowed quantization values for a high frequency subband of said image sequence than for a low frequency subband of said image sequence; and

(d) recursively adjusting the target frame bit rate for subsequent frames in the sequence.

6. I understand that another independent claim of the above-identified application is directed to an apparatus for encoding frames of an image sequence, each frame comprising a plurality of objects, said apparatus comprising:

a motion compensator for generating a predicted image of a current frame;

a transform module for applying a transformation to a difference signal between the current frame and said predicted image, where said transformation produces a plurality of coefficients;

a quantizer for quantizing said plurality of coefficients with at least one quantizer scale for each object in the frame; and

a controller for generating the at least one quantizer scale for each of said plurality of objects in accordance with a target object bit rate, wherein said quantizer scale(s) provide coarser and/or fewer allowed quantization values for a high frequency subband of said image sequence than for a low frequency subband of said image sequence, selectively adjusting said at least one quantizer scale for the current frame in response to said target object bit rate for each of the plurality of objects, and determining said target object bit rate from a target frame bit rate, T_{frame}, in accordance with the formula:

$$V_i = K_i \times T_{frame}$$

where V_i is a target object bit rate for each object, and K_i is proportional to an average pixel value for the object.

7. I understand that a third independent claim of the above-identified application is directed to a computer-readable medium having stored thereon a plurality of instructions which, when executed by a processor, perform steps comprising:

(a) determining a target frame bit rate, T_{frame}, for a frame in an image sequence in accordance with a quantizer scale for each object in the frame, wherein said each frame includes a plurality of objects; and

(b) allocating said target frame bit rate among the plurality of objects in accordance with the formula:

$$V_i = K_i \times T_{frame}$$

where V_i is a target object bit rate for each object, and K_i is proportional to an average pixel value for the object;

(c) generating the quantizer scale for each of said plurality of objects in accordance with said target object bit rate, wherein said quantizer scale provides coarser and/or fewer allowed quantization values for a high frequency subband of said image sequence than for a low frequency subband of said image sequence; and

(d) recursively adjusting the target frame bit rate for each frame in the sequence.

8. Eleftheriadis discloses a method and apparatus for performing digital image and video segmentation and compression using 3-D depth information (Title). In contrast to paragraphs 5-7 above, which recite allocating the target object bit rate(s) in accordance with the target frame rate and ***an average pixel value*** for the object, Eleftheriadis appears to determine a target object bit rate based on a quantizer (the value of which appears to be related to the distance of the object from the camera; see, e.g., col. 11, ll. 1-15 and 41-44) and **the proportion of pixels in the object** (see, e.g., col. 11, l. 65-col. 12, l. 10; emphasis added).

9. Thus, Eleftheriadis is deficient with respect to the method, apparatus and computer-readable medium of paragraphs 5-7 above.

10. Eleftheriadis does not disclose allocating a target frame bit rate among the objects in a frame according to ***an average pixel value*** for the object, nor does Eleftheriadis et al. appear to disclose the present step of generating a quantizer scale for each object that provides coarser and/or fewer allowed quantization values for a high frequency subband than for a low frequency subband of the image sequence (see paragraphs 5-7 above). While Eleftheriadis mentions the quantization of pixels and frames that comprise a plurality of objects, one benefit of the present

claimed method is that the target bit rates can be prioritized based on the relative need of the objects for the available bits (as reflected by ***the average pixel value***) in a given application, rather than on the size of the objects.

11. Furthermore, Eleftheriadis does not disclose a controller for generating such a quantizer scale and determining the target object bit rates from a target frame bit rate in accordance with an average pixel value for the objects (see paragraph 6 above).

12. Allocating a target frame bit rate among the objects in a frame according to ***an average pixel value*** for the object is advantageous because it provides more efficient use of encoder bandwidth relative to determining an object bit rate according to the frame bit rate and the number of pixels in the object, as taught by Eleftheriadis.

13. In combination with generating the quantizer scale for each object in accordance with the target object bit rate, allocating a target frame bit rate among the objects in a frame according to ***an average pixel value*** for the object enables objects of interest to receive a higher bit rate than objects of lesser interest, regardless of the number of pixels in (or size of) the object.

14. One advantage of the method is that an object having a smaller number of pixels, but needing more bits (e.g., in terms of encoding syntax information, motion information and/or shape information; see, e.g., page 14, lines 2-7 of the present specification) can have a greater proportion of the available bandwidth, or target frame bit rate, than a larger object that does not need as many bits. In contrast, the approach of Eleftheriadis appears to assign a certain proportion of the available frame bandwidth based solely on the size of the object, without reference to the relative need for encoding bits by the various objects in the frame.

15. Klein Gunnewiek is silent with regard to allocating or determining an object bit rate according to an average pixel value of the object. Thus, Klein Gunnewiek fails to cure this deficiency of Eleftheriadis regarding the method, apparatus and computer-readable medium of paragraphs 6-8 above.

16. Neither Eleftheriadis nor Klein Gunnewiek disclose quantizing high frequencies more coarsely and/or with fewer allowed values than low frequencies or the possible benefits thereof.

17. Eleftheriadis also does not allocate a frame bit rate among objects in the frame, as recited in paragraphs 5-7 above. Instead, Eleftheriadis determines object bit rates, adds them up, then adjusts the total frame bit rate based on buffer fullness (see the discussion below). Thus, Eleftheriadis takes a "bottoms up"-type approach to determining object and frame rates, whereas the method, apparatus and medium of paragraphs 5-7 above use a "tops down"-type of approach.

18. Eleftheriadis discusses two coding techniques for controlling bit rates, variable bit rate (VBR) coding and constant bit rate (CBR) coding (see col. 8, ll. 8-19 and col. 11, ll. 39-64). Eleftheriadis discloses a constant bit rate encoder (FIG. 10), in which an object map generated by object segmentation circuit 500 is received by a macroblock labeling circuit 1100 (see col. 10, l. 65-col. 11, l. 1). Since the encoder splits each frame of video information received from the camera into macroblocks and quantizes DCT coefficients on a macroblock basis, Eleftheriadis teaches that it is desirable to assign each macroblock of video data to a specific object, or in the case of a simple segmentation technique described therein, to a region which contains one or more objects at the same depth from the camera (col. 11, ll. 1-8). Once the macroblock including pixels from an object or region has been assigned, it will be assigned to one object or region by macroblock labeling circuit 1100, a rate controller 1040 can select an appropriate quantizer step size for the entire current macroblock (col. 11, ll. 12-15).

19. For CBR coding, the rate controller 1040 must additionally regulate quantizer selection so that the output buffer 1020 neither overflows nor underflows. ***Since the total number of bits per second which may be output is now fixed***, object sizes become important (col. 11, ll. 53-57; emphasis added). In accordance with a known technique for performing area-selective rate control when the object locations are known, each object is associated with a particular target average bit rate R_i, except for the background (object n). Thus, in CBR coding, Eleftheriadis appears to determine a target object bit rate based on a quantizer value, rather than an allocation in accordance with the target frame rate, as recited in paragraphs 5-7 above.

20. In order to maintain the given total average rate R necessary to prevent buffer overflow, the background rate is determined according to EQ. (4):

$$\sum_{i=0}^{n} a_i R_i = R \tag{4}$$

where α_i is the proportion (from 0.0 to 1.0) of the pixels in the frame that belong to object i (col. 11, l. 67-col. 12, l. 10; emphasis added).

21. Thus, Eleftheriadis clearly determines a target object bit rate based on the proportion of pixels in the object, rather than ***an average pixel value*** for the object, as explained above.

22. Eleftheriadis explicitly teaches that it is possible that R_0 (the background bit rate) is negative (col. 12, l. 16). To one of ordinary skill in the art, this possibility of a negative background bit rate demonstrates that target object bit rates are not allocated in accordance with a target frame rate. Rather, they must be determined by some other technique (such as in accordance with a quantizer value, as explained above, which in turn appears to be based on the occupancy B_{max} of a buffer [col. 13, ll. 22-26], the output rate of which is constant and dependant on the bandwidth of the channel which is accepting data from the buffer; see col. 13, ll. 17-22).

23. Eleftheriadis further teaches that the possibility of a negative background bit rate may simply have the effect of assigning as coarse quantization as possible to the background, and may result in less average bits per second per object than the target bit rates R_i indicate (col. 12, l. 16-19), further confirming that ***target*** object bit rates therein are not allocated in accordance with a target frame rate.

24. Thus, there appears to be no reasonable basis in Eleftheriadis for an assertion that EQ. (4) of Eleftheriadis is used to determine the target frame rate; to the extent R may be related to a target frame rate, Eleftheriadis teaches that it is given (e.g., determined *a priori*, and dependent on the bandwidth of the channel which is accepting data from the buffer). Furthermore, the rate control performed by placing a buffer 320 at the output 310 of the variable bit rate (VBR) encoder 200 and having a rate controller 340 takes into account the occupancy of

the buffer and other parameters that are possibly signal dependent in order to decide the quantizer step size in quantizer 251, so that the buffer does not overflow or underflow (col. 8. ll. 17-27, and Fig. 2-3). Consequently, in the relevant discussion of CBR coding, Eleftheriadis fails to disclose step of allocating the target frame bit rate in accordance with a target object bit rate as recited in the method, apparatus and computer-readable medium of paragraphs 5-7 above.

25. Also, as discussed above, since Eleftheriadis teaches that the frame bit rate is related to the occupancy of a buffer having a constant output rate that is, in turn, dependent on the bandwidth of the channel which is accepting data from the buffer, Eleftheriadis cannot disclose or suggest to one of ordinary skill in the art that the frame bit rate can be (much less should be) adjusted. Thus, Eleftheriadis appears to be silent with regard to recursively adjusting a target frame rate, as recited in paragraphs 5 and 7 above.

26. For VBR coding, Eleftheriadis teaches that macroblock labels can be directly used for rate control by associating particular quantizer step sizes with each object (col. 11, ll. 39-41). The encoder can also employ techniques to "smooth out" quantizer differences at object boundaries by gradually changing the quantization step while entering or exiting an object (col. 11, ll. 47-50). A macroblock labeling circuit 1100 (see FIG. 11) contains object identifications for each pixel in the macroblock (col. 11, ll. 16-19), and quantizer selection is simply a lookup operation into a table which indexes the possible object identifications generated by macroblock labeling circuit 1100 (col. 11, ll. 44-47). Also, Eleftheriadis teaches that rate control is also usable in a purely VBR encoder to provide higher quality for some image areas, and less for areas that have smaller significance (e.g., background areas). As a result, the term rate control is used by Eleftheriadis generally without discriminating whether or not a CBR or VBR encoder is used (col. 8, ll. 40-47). Thus, the discussion of VBR coding by Eleftheriadis fails to cure any deficiency of Eleftheriadis with regard to the allocating step in paragraphs 5 and 7 above.

27. Consequently, Eleftheriadis fails to disclose allocating the target frame bit rate among a plurality of objects in the frame in accordance with an average pixel value for the object, as recited in paragraphs 5-7 above.

28. Allocating the target frame bit rate among a plurality of objects in the frame provides for more efficient use of encoder bandwidth and reduces the risk of buffer overruns, relative to the approach of Eleftheriadis (which can assign or allow a total of the object bit rates that is greater than the total bit rate for the frame). Reducing the risk of buffer overruns also reduces the probability of skipping frames, which can affect the quality of a digital video picture stream.

29. Furthermore, Eleftheriadis fails to disclose the controller of paragraph 6 above, which determines the target object bit rate from a target frame bit rate in accordance with an average pixel value for each of the objects. As discussed above, Eleftheriadis determines a target object bit rate based on ***the proportion of pixels in the object***, rather than an average pixel value for the object. In addition, Eleftheriadis discloses a rate controller 1040 that regulates quantizer selection so that the output buffer 1020 neither overflows nor underflows (col. 11, ll. 53-57). However, the output rate of the buffer is constant and dependant on the bandwidth of the channel which is accepting data from the buffer (see col. 3, ll. 17-26). Eleftheriadis does not appear to disclose any connection between the bandwidth of the channel which is accepting data from the buffer and a target frame bit rate. As a result, Eleftheriadis is deficient with regard to the method described in paragraph 5 above.

30. Klein Gunnewiek discloses a device for encoding a video signal comprising means for dividing each picture into a plurality of sub-pictures, an encoder comprising a picture transformer for transforming each sub-picture into coefficients, and a quantizer for quantizing the coefficients with an applied step size (col. 1, ll. 5-10). Klein Gunnewiek neither discloses nor suggests allocating a target frame bit rate among the object(s) in a frame according to an average pixel value for the object, nor does Klein Gunnewiek disclose or suggest generating a quantizer scale for each of the objects in accordance with the target object bit rate, the quantizer scale providing coarser and/or fewer allowed quantization values for a high frequency subband than for a low frequency subband of the image sequence.

31. There is no reasonable basis for interpreting either cited reference as disclosing a target object bit rate determined and/or based on ***an average pixel value***. The constant values K_P

and K_B of Klein Gunnewiek are not average pixel values, regardless of how they may be applied in an equation. Instead, they are constants that are related only to the gain of the encoder and the quantizer step size (col. 3, ll. 11-15, and col. 4, l. 44-col. 5, l. 10 of Klein Gunnewiek). Thus, the constant values K_P and K_B of Klein Gunnewiek are constants of the system, and are arguably not related to ***pixel values*** at all.

32. As a result, the average pixel value K_I as recited in paragraphs 5-7 above has a different nature (e.g., it is a variable) than K_P and K_B of Klein Gunnewiek, and it is not an obvious design choice or variation to one of ordinary skill in the art to substitute an object-based variable for a constant of the system.

33. Thus, Klein Gunnewiek fails to cure the deficiencies of Eleftheriadis with respect to allocating the target frame bit rate among the objects in each frame in accordance with an average pixel value for the object, as recited in paragraphs 5 and 7 above. Similarly, Klein Gunnewiek fails to cure the deficiencies of Eleftheriadis with respect to a controller for doing the same, as recited in paragraph 6 above. Consequently, no possible combination of Eleftheriadis and Klein Gunnewiek can suggest the method, apparatus and computer-readable medium of paragraphs 5-7 above.

34. Stone does not cure the deficiencies of Eleftheriadis and Klein Gunnewiek with regard to the method, apparatus and computer-readable medium of paragraphs 5-7 above.

35. Stone discloses compressing a digital video signal by spatial sub-band filtering to form data sets constituting respective sub-bands of the two-dimensional spatial frequency domain (Abstract, ll. 1-3). The data sets for a field or frame are stored, and a first sequencer controls writing the stored data to a quantizer in which they are quantized in accordance with respective values, those values being such that the amount of quantization of at least a data set constituting a sub-band to which dc luminance information of the signal is at least predominantly confined is less than the average of the amounts of quantization of the remaining data sets (Abstract, ll. 4-12).

Atty. Docket No. MTKI-04-332A-1
Serial No: 09/401,132

36. Stone further discloses intra-image compression in the time domain by the use of differential pulse code modulation, in which a predictor is used to predict the values of samples representing pixels based on previous pixel values because image pixels are highly correlated, and the small and uncorrelated error can be encoded using fewer bits than the samples representing the original pixels (col. 1, ll. 27-37). Stone suggests that a selective quantization operation and/or entropy encoding in accordance with the description therein can lead to bit rate reduction (col. 15, ll. 45-52; col. 18, ll. 39-46; and col. 20, ll. 24-46).

37. Stone is silent with regard to (a) allocating the target frame bit rate in accordance with a target object bit rate and/or (b) allocating a target frame bit rate among the objects in each frame in accordance with ***an average pixel value*** for the object, as recited in paragraphs 5-7 above.

38. Thus, Stone fails to cure the deficiencies of Eleftheriadis and Klein Gunnewiek with respect to the method, controller and computer-readable medium of paragraphs 5-7 above. Consequently, no possible combination of Eleftheriadis, Klein Gunnewiek and Stone can suggest the method, apparatus and computer-readable medium of paragraphs 5-7 above.

Further, Declarant sayeth not.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the above-identified application or any patent issued thereon or therefrom.

Jonathan LIOU

10. 09. 2007
Date